

Application No. 10/686,892

K&S-121US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No: 10/686,892
Applicant: Rakesh Batish et al.
Filed: October 16, 2003
Title: SYSTEM AND METHOD FOR PREVENTING AND ALLEVIATING SHORT
CIRCUITING IN A SEMICONDUCTOR DEVICE
TC/A.U.: 2815
Examiner: S. Clark
Confirmation No.: 7548
Docket No.: K&S-121US

COMMUNICATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

S I R :

In response to the requirement set forth by the Examiner during a teleconference with Applicants' representative on September 14, 2004, Applicants have submitted herewith a Declaration Under 37 C.F.R. § 1.131 to overcome a publication of one of the inventors. Applicants respectfully request entry and consideration of the Declaration.

In order to expedite prosecution of the above-identified application, Applicants invite the Examiner to contact Applicants' representative with any questions relating to the application.

Respectfully submitted,

RatnerPrestia


Jacques L. Etkowicz, Reg. No. 41,738
Attorney for Applicants

JLE/kc

Enclosures

Dated: September 15, 2004

P. O. Box 980
Valley Forge, PA 19482
(610) 407-0700

The Commissioner for Patents is hereby authorized to charge payment to Deposit Account No. 18-0350 of any fees associated with this communication.

I hereby certify that this correspondence is being facsimile transmitted to the United States Patent and Trademark Office (Fax No. (571) 273-1726) on September 15, 2004


Kathleen Carney

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FAX FILING IN U.S. PATENT & TRADEMARK OFFICEDATE: September 15, 2004

TIME: _____

TO: Examiner S. Clark FAX NO.: (571) 273-1726

FROM: Jacques L. Etkowicz ADMIN. ASST.: Kathleen Carney

APPLN. NO.: 10/686,892 ATTY. DOCKET NO.: K&S-121US

TITLE OF APPLN.: SYSTEM AND METHOD FOR PREVENTING AND ALLEVIATING SHORT CIRCUITING IN A SEMICONDUCTOR DEVICE

FILING DATE: October 16, 2003 ART UNIT: 2815

FIRST INVENTOR: Rakesh Batish CONF. NO.: 7548

TITLE OF DOCUMENT (and List of Attachments): DECLARATION UNDER 37 CFR 1.131

Transmittal Form, Communication, Declaration Under 37 CFR 1.131, Exhibits 1, 2

Total Number of Pages: 29 (including this form)**COMMENTS****CONFIDENTIAL AND PRIVILEGED ATTORNEY/CLIENT INFORMATION**

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Please notify us immediately if you have not received the number of pages indicated above.

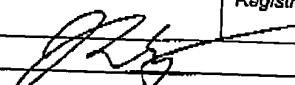
PTO/SB/21 (04-04) (AW 06/2004)

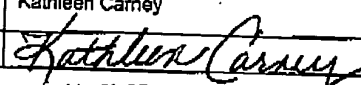
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TRANSMITTAL FORM <i>(to be used for all correspondence after initial filing)</i>	Application Number	10/688,892	
	Filing Date	October 16, 2003	
	First Named Inventor	Rakesh Batish	
	Art Unit	2815	
	Examiner Name	S. Clark	
Total Number of Pages in This Submission	29	Attorney Docket No.	K&S-121US

ENCLOSURES (Check all that apply)		
<input type="checkbox"/> Fee Transmittal Form <input type="checkbox"/> Fee Attached <input type="checkbox"/> Amendment/Reply <input type="checkbox"/> After Final <input type="checkbox"/> Affidavits/Declaration(s) <input type="checkbox"/> Extension of Time Request <input type="checkbox"/> Express Abandonment Request <input type="checkbox"/> Information Disclosure Statement <input type="checkbox"/> Certified Copy of Priority Document(s) <input type="checkbox"/> Response to Missing Parts/ Incomplete Application <input type="checkbox"/> Response to Missing Parts under 37 CFR 1.52 or 1.53	<input type="checkbox"/> Drawing(s) <input type="checkbox"/> Licensing-related Papers <input type="checkbox"/> Petition <input type="checkbox"/> Petition to Convert to a Provisional Application <input type="checkbox"/> Power of Attorney, Revocation, Change of Correspondence Address <input type="checkbox"/> Terminal Disclaimer <input type="checkbox"/> Request for Refund <input type="checkbox"/> CD, Number of CD(s) _____	<input type="checkbox"/> After Allowance Communication to Technology Center (TC) <input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences <input type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief) <input type="checkbox"/> Proprietary Information <input type="checkbox"/> Status Letter <input checked="" type="checkbox"/> Other Enclosure(s) (please Identify below): PTO Faxsheet Declaration Under 37 CFR 1.131 with Exhibits 1, 2 USPTO Communication
Remarks:		

SIGNATURE OF APPLICANT, ATTORNEY OR AGENT			
Firm or Individual Name	Jacques L. Etkowicz	Registration No. (Attorney/Agent)	41,738
Signature			
Date	September 15, 2004		

CERTIFICATE OF FACSIMILE TRANSMISSION			
I hereby certify that this correspondence is being facsimile transmitted to the USPTO to (571) 273-1726, Commissioner for Patents, Alexandria, VA 22313-1450 on the date shown below:			
Typed or printed name	Kathleen Carney	Date	September 15, 2004
Signature			

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, ALEXANDRIA, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

K&S-121US

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln. No: 10/686,892
Applicant: Rakesh Batish et al.
Filed: October 16, 2003
Title: SYSTEM AND METHOD FOR PREVENTING AND ALLEVIATING
SHORT CIRCUITING IN A SEMICONDUCTOR DEVICE
TC/A.U.: 2815
Examiner: S. Clark
Confirmation No.: 7548
Docket No.: K&S-121US

DECLARATION UNDER 37 C.F.R. § 1.131

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

S I R :

We, Rakesh Batish, C. Scott Kulicke, Andrew Hmiel and Walt
VonSeggern, hereby declare that:

1. We are the co-inventors of the subject matter of the patent application identified above and are familiar with the contents of that patent application.
2. The purpose of this declaration, which is submitted before final rejection of the subject patent application, is to establish completion of the invention of the subject matter disclosed in the application in the United States at a date before the publication date of an article by Andrew Hmiel et al. entitled "Wire Bond Short Reduction By Encapsulation", SEMI Technology Symposium: International Electronics Manufacturing Technology Symposium, 2003, SEMICON West, San Jose CA ("the Hmiel reference").
3. All of the acts described in this declaration took place within the United States.

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4. At the time of our contribution to the conception and reduction to practice of the invention, each of us Inventors was an employee of Kulicke and Soffa Industries Incorporated ("K&S"). The assignee of the present invention, Kulicke & Soffa Investments is a wholly owned subsidiary of Kulicke and Soffa Industries.

5. We conceived of the invention disclosed and claimed in the subject application before the publication date of the Hmiel reference.

6. We next submitted an Invention Disclosure form disclosing our invention to our employer, Kulicke and Soffa Industries, still before the publication date of the Hmiel reference.

7. Still before the publication date of the Hmiel reference, the K&S Legal Department received our Invention Disclosure form and began evaluation of the merits of our invention to determine whether to file a patent application.

8. The K&S Legal Department subsequently completed its evaluation and requested that the law firm of RatnerPrestia prepare a patent application covering our invention of a method for preventing and alleviating the short circuiting in a semiconductor device.

9. Draft applications were completed by Ratner & Prestia, reviewed and revised by us as the inventors. The final draft application was submitted to us for final review and approval. RatnerPrestia was then authorized by us to file the subject patent application in the United States Patent and Trademark Office.

10. From the time of conception and reduction to practice, we diligently worked with patent attorneys, both internal and external to K&S, to prepare and file the subject patent application. At no time was the invention abandoned, suppressed, or concealed.

11. The invention covered in the subject patent application was neither disclosed to anyone outside of K&S without a confidentiality agreement

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nor on sale or in public use more than one year before the filing of the application.

12. That Exhibits 1 and 2 represent documents internal to the Kulicke and Soffa Industries Incorporated and were created and distributed in a confidential manner.

13. That from the above statements and the documents contained in Exhibits 1 and 2, it can be seen that the invention in this application was made before the publication date of the Hmiel reference.

14. That the following exhibits are attached to this Declaration:

EXHIBITDESCRIPTION

1

Copy of confidential invention disclosure including lab notes and data results showing the reduction of the present invention.

2

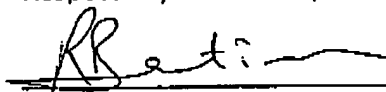
Copy of drawings provided to patent counsel for incorporation in patent application.

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- 4 -

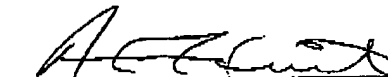
15. By each of our signatures below, we hereby declare that all statements made in this document of our own knowledge are true, and that all statements made on information and belief are believed to be true. Further, we hereby declare that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing on the application.

Respectfully Submitted,

Dated: Sept. 14, 2004
Rakesh Batish

Dated: _____

C. Scott Kulicke

Dated: Sept. 14, 2004
Andrew Hmiel

Dated: _____

Walt VonSeggern

K&S-121US

- 4 -

15. By each of our signatures below, we hereby declare that all statements made in this document of our own knowledge are true, and that all statements made on information and belief are believed to be true. Further, we hereby declare that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing on the application.

Respectfully Submitted,

Dated: _____

Rakesh BatishDated: 9-14-04_____
C. Scott Kulicke

Dated: _____

Andrew Hmiel

Dated: _____

Walt VonSeggern

K&S-121US

- 4 -

15. By each of our signatures below, we hereby declare that all statements made in this document of our own knowledge are true, and that all statements made on information and belief are believed to be true. Further, we hereby declare that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing on the application.

Respectfully Submitted,

Dated: _____

Rakesh Batish

Dated: _____

C. Scott Kulicke

Dated: _____

Andrew Hmiel

Dated: 9/14/04

Walter VonSeggern
Walt VonSeggern

EXHIBIT 1



Kulicke & Soffa
Industries, Inc.

Company Confidential

DISCLOSURE INFORMATION

KSI #	Account #	Date Received:	
Location: Willow Grove	Organization: Corporate Research & Development	File/Docket #	
Title of Invention: Method for Alleviation of Shorted Wirebonds in Ultrafine and Fine Pitch Devices			
Inventor(s) - Full Name(See also Page #2): Andrew F. Hmiel			
Prepared By: Andrew F. Hmiel	Date:	Supervisor: Glenn Sandgren	Patent Rep.:
Brief Description: The method describes the application and cure of a polymer material that is filled with a defined distribution of an inorganic powder such that the material smoothly flows through the very fine spacing between wires in an ultrafine pitch wirebonded device. The property claimed by this disclosure is the specific movement of the wires that may be touching such that after the application of the encapsulant, the wires are no longer touching, and are insulated by the inorganic powder. The process includes the methodology of dispensing the material to enhance short removal capability which will insure protection against shorting during the resin transfer molding process or when used with a glob top encapsulant.			
<i>Attach copies of all descriptive material and sketches (including notebook entries, technical memos, schematics, etc.) necessary to convey concept.</i>			
Purpose: The use of the encapsulant (NoSWEEP [®]) material and process reduces wire shorts during the assembly of ultra fine pitch wirebonded devices. The method allows an enhancement to the device production yield in both globtop encapsulating and when utilizing resin transfer molding when encapsulant is applied after wirebonding.			
What is new or different? The application of a wirebond encapsulant such that the scale of the filler particles is explicitly added in specific sizes and quantities to improve ability of the material to flow between and separate shorted wire pairs. Small diameter inorganic particles are then allowed to fill in between the wires. Furthermore, the type of polymer resin materials enhance the surface energy properties of the encapsulant to maximize the short stopping property.			
Advantages over past practice: The method allows packages with longer, thinner wires and a higher density of I/O connections at smaller pad pitch to be constructed, and will increase the yield of such devices through post-bond substrate handling and the molding and/or globtop encapsulation process.			
Identify first written record:			
I: Plan for experiment titled "Assy for No Short Proof", dated			
Date and names of those to whom first disclosed and/or first test:			
I: Report titled "Short Stop Report -I" dated			
II: Lab notebook of experiment dated			
III: Lab notebook description of the process dated			
Other writings: publications, patents, products which relate to this invention:			
Additional writings, publications, patents are included below.			
Source	System/ Program:	Project No.	Other:
Signature of witness:	Date:	Signature of inventor:	Date:
Signature of witness:	Date:	Signature of co-inventor:	Date:
Signature of witness:	Date:	Signature of co-inventor:	Date:



Kulicke & Soffa
Industries, Inc.

Company Confidential

GMB

DISCLOSURE INFORMATION

Name:	Date	KSI-
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Inventor 1:

Full Name: Andrew F. Hmiel
Home Address: 2150 Wharton Road
Home Address:
City, State, Zip: Glenside, PA 19038
Country: USA
Citizenship: USA

Inventor 2:

Full Name: Rakesh Batish
Home Address: 189 Abbey Drive
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Country: U.S.A.
Citizenship: U.S.A.

Inventor 3:

Full Name: Glenn Sandgren
Home Address: 1340 McAuley Court
Home Address:
City, State, Zip: Ambler PA, 19002
Country: USA
Citizenship: USA

Inventor 4:

Full Name: C. Scott Kulicke
Home Address:
Home Address:
City, State, Zip: Fort Washington, PA
Country: USA
Citizenship: USA

Name:	Date	KSI-
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DISCLOSURE INFORMATION

Where is it used (or to be used)? QFP, BGA and Array BGA assembly, after wirebonding and before overmolding or glob top encapsulation.

When was it, or will it, be exhibited or shown:

- to the public? N/A
- to anyone outside K&S? N/A

Is it included in a non-disclosure Agreement? (if one exists) No.

To your knowledge, what is the prior art (Machine/Equipment, Publications, Patents)? See below.

Additional writings, publications, patents, products which relate to this invention:

References Cited
U. S. Patent Documents

6,340,846	1/22/2002	LoBianco et al.
6,368,899	4/2002	Featherby et al.
6,344,401	2/2002	Lam
6,340,846	1/2002	LoBianco et al.
6,297,078	10/2001	Barrow
6,215,182	4/2001	Ozawa et al.
5,824,568	10/1998	Zechman
5,818,105	10/1998	Kouda
5,434,105	7/1995	Liou
5,331,205	7/19/1994	Primeaux
5,206,794	4/27/1993	Long
4,974,057	11/27/1990	Tazima
4,788,583	11/29/1988	Kawahara et al.
Japan patent 62-73646	4/1987	Sasamoto

RELATED APPLICATIONS



**Kulicke & Soffa
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DISCLOSURE INFORMATION

SUMMARY OF THE INVENTION

The first embodiment of the process intended to increase the yield of semiconductors by preventing shorts of fine pitch, small diameter wirebonded devices after molding or glob top encapsulation is encompassed by the integrated method of:

1. Applying an encapsulant filled with a combination of small and intermediate size spherical silica.
2. The application is performed on a wirebonder immediately after bonding.
3. The material is cured or gelled on the wirebonder by heat and exposure to UV visible and/or IR radiation or by a thermal batch process

The second embodiment of the process is encompassed by the integrated method of:

1. Applying an encapsulant filled with a combination of small and intermediate size spherical silica.
2. The application is performed on an automatic dispensing machine as soon as practical after wirebonding.
3. The material is cured or gelled by heat and exposure to UV, visible and/or IR radiation or by a thermal batch process.

Additional information & comments:

The invention describes an encapsulant material and a process for the application of the encapsulant material so that shorted wires can be separated and the short condition will be removed. The epoxy encapsulant material is formulated such that the spherical filler size is much smaller than the space left between the wires in an ultrafine pitch wirebonded device. In addition, the encapsulant is designed such that a specific intensity, duration and wavelength distribution of UV, visible and/or IR radiation, the material rapidly gels or partially cures the material. The device is normally heated to a temperature of 80 - 100°C and the encapsulant material dispenser is also heated to a temperature of from 50 - 70 °C to aid in the dispensing process. The filler material is assembled from combinations of silica with size distributions for the following purposes: (1) To carry small silica particles into the narrow space between wire loops, thereby driving the wires apart (2) to force the silica to achieve a high electrical isolation between the wires and (3) to the means for fixing the silica and the polymer in place to sustain the electrically insulating capabilities.

The process includes the methodology of dispensing and curing the material on the wirebonding machine such that the delicate loops of the thin wire are preserved immediately after bonding. The means by which the dispensing occurs is such that while the successive device or devices are being wirebonded, the dispensing and curing operations are being applied to the assembly. Two embodiments of the process define the method of cure. In the first embodiment the encapsulant is applied immediately after wirebonding and the cure or gel is performed by the application of heat and UV (ultraviolet) exposure or by a thermal batch process. In the second embodiment, the encapsulant is applied as soon as practical after wirebonding using an automatic dispensing machine for the application and heat and a UV exposure perform the encapsulant cure or gel or by a thermal batch process.

The invention has the following benefits:

The filler allows the material to fill in between the wires and the fine features of a device that utilizes ultra fine pitch wirebonding. It allows the use of much less volume of potentially higher cost material than if the entire package were molded with the same material. It allows very low cost conventional molding compound or glob top encapsulation materials and equipment to be used to complete the package.

The method of the first embodiment requires the following:

A new subsystem must be added to the wirebonder. A new step in the packaging process is introduced.

The method of the second embodiment requires the following:

A dispensing system must be used to apply the material to the wirebonded parts. A new step in the packaging process is introduced.

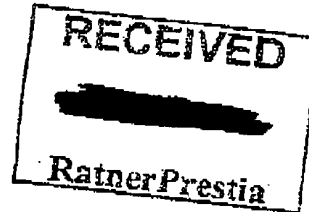
The comprehensive parts of the method ensure that the packaging process does not suffer reduction in productivity with the inclusion of this method. By the institution of software controls and sensor fusion, the system integrates the functions of dispensing and encapsulant cure such that the time the system is occupied while wirebonding, the added functions are carried out. As the packaging processing continues to Resin Transfer Molding or Glob top encapsulation of the device, the fine wires are entirely protected from any short creating motion due to the rapid flow of the molding compound or encapsulant.

EXHIBIT 2



Kulicke & Soffa Industries Inc.
Polymer Products

2101 Blair Mill Road Willow Grove, PA 19090
Phone: 215-784-6100 Fax: 215-784-6101

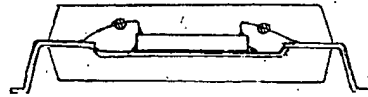
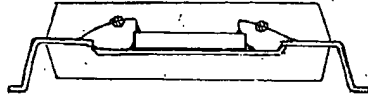
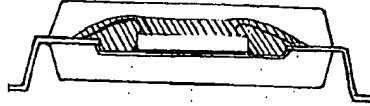


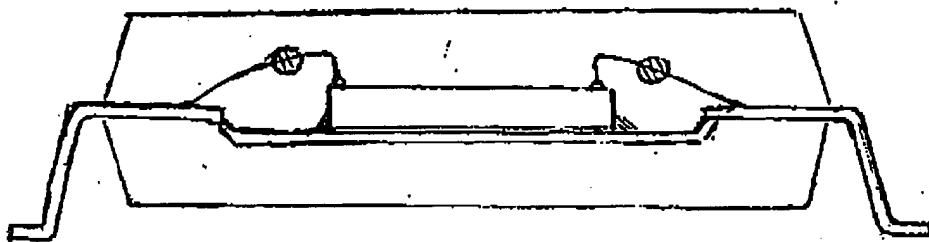
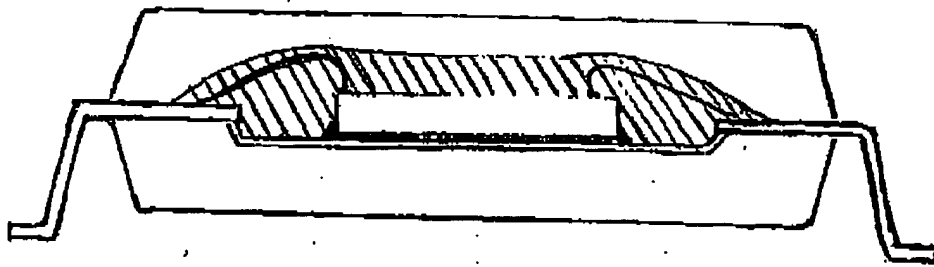
FAX To: Chris Spletzer
FAX No.: 610.407.0701
FROM: Andrew Hmiel
DATE: [REDACTED]

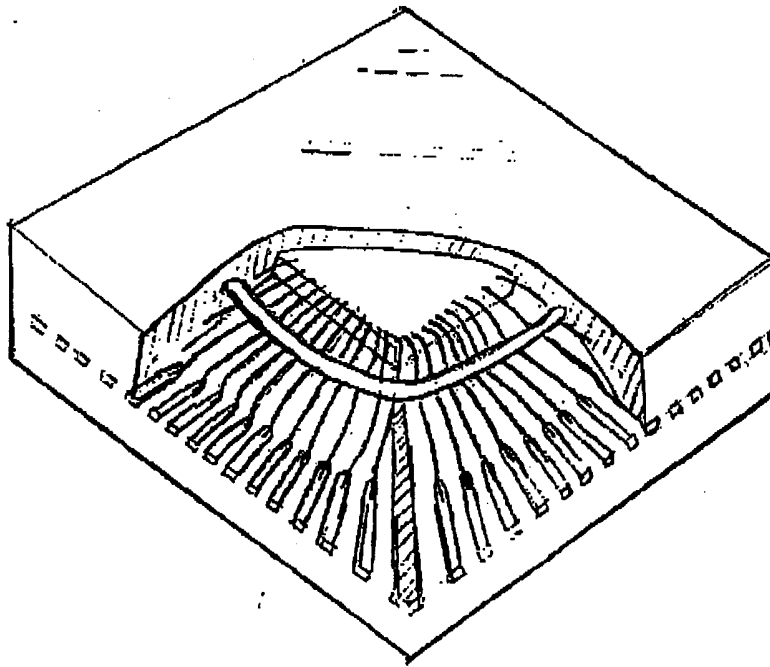
Chris - Please see email

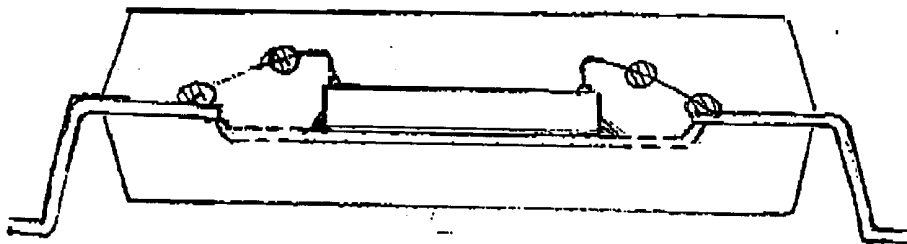
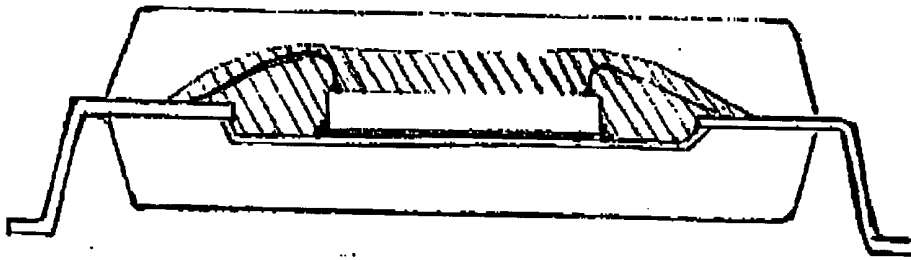
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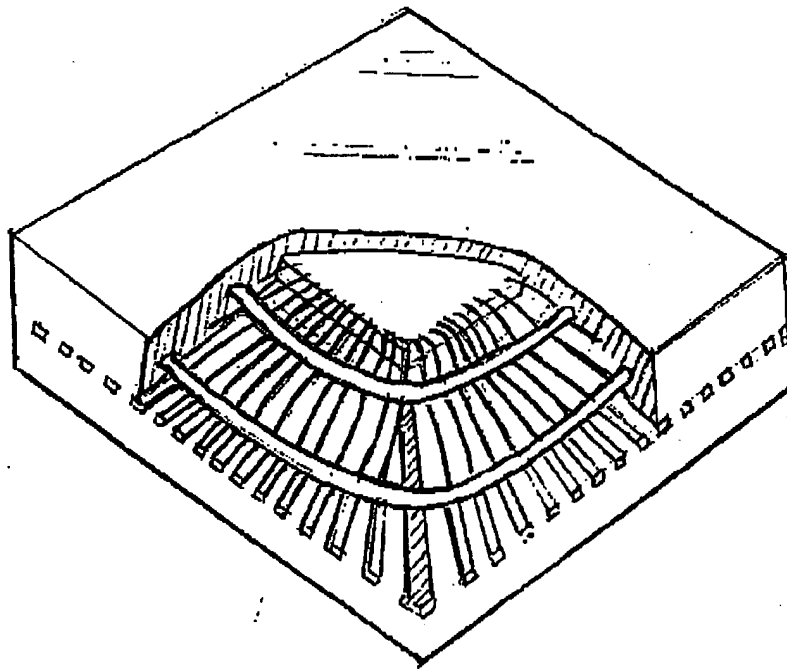
- Andrew



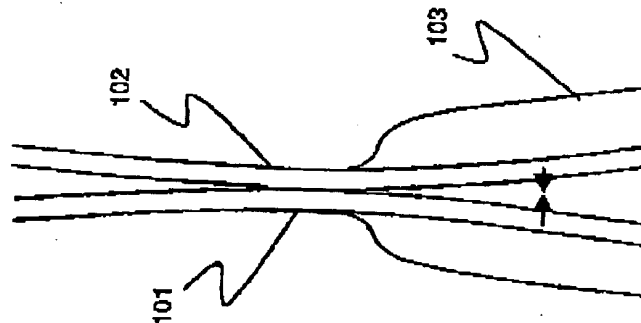




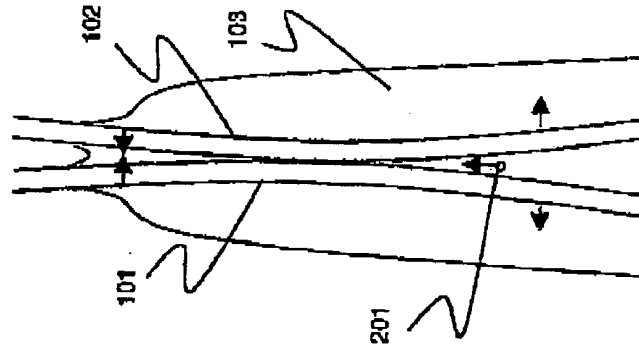




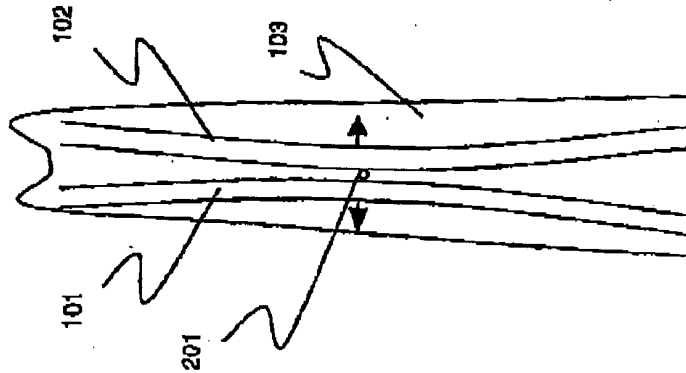
View 100: Wire (101) shorted with wire (102). Encapsulant (3) has been applied to the wires. The capillary force is directed toward pushing the wires together.

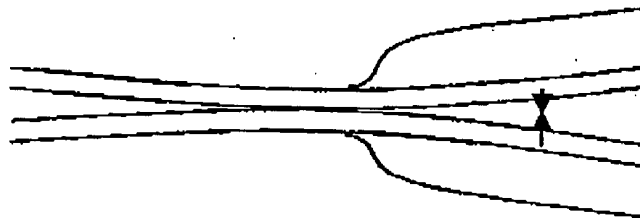
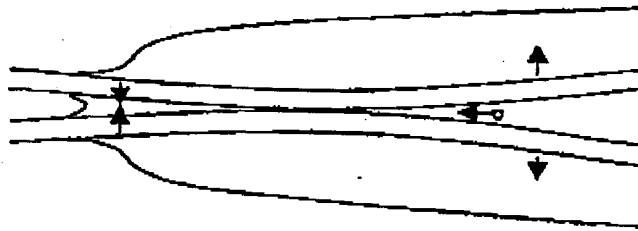
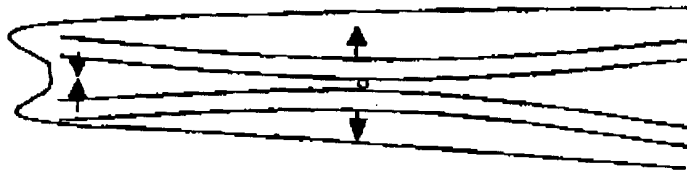


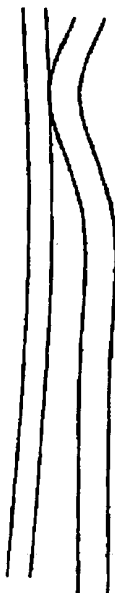
View 200: Wire (101) remains shorted with wire (102). The encapsulant (103) has covered most of the wire length and is drawing silica particles (201) into the space between the wires. The capillary force, leveraged against the contact, now acts to open the wire gap from below.



View 300: The encapsulant (103) has fully covered wires (101) and (102). The silica particle (201) has been drawn into the gap by the relaxation of the wires seeking their equilibrium positions.







Typography of shorted bond wires.

Type 100

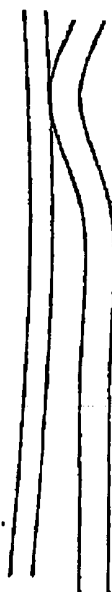
Wires gently bent, short occurs
When one wire touched another,
One wire or both wires may curve
Toward each other



100

Type 200

One wire kinked,
the short is located
where the kink touched
adjacent wire



200

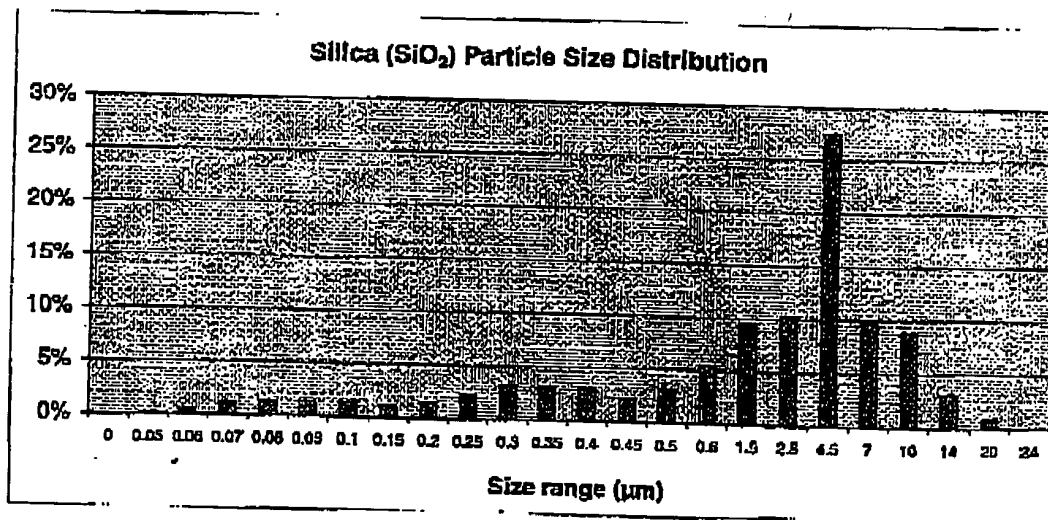
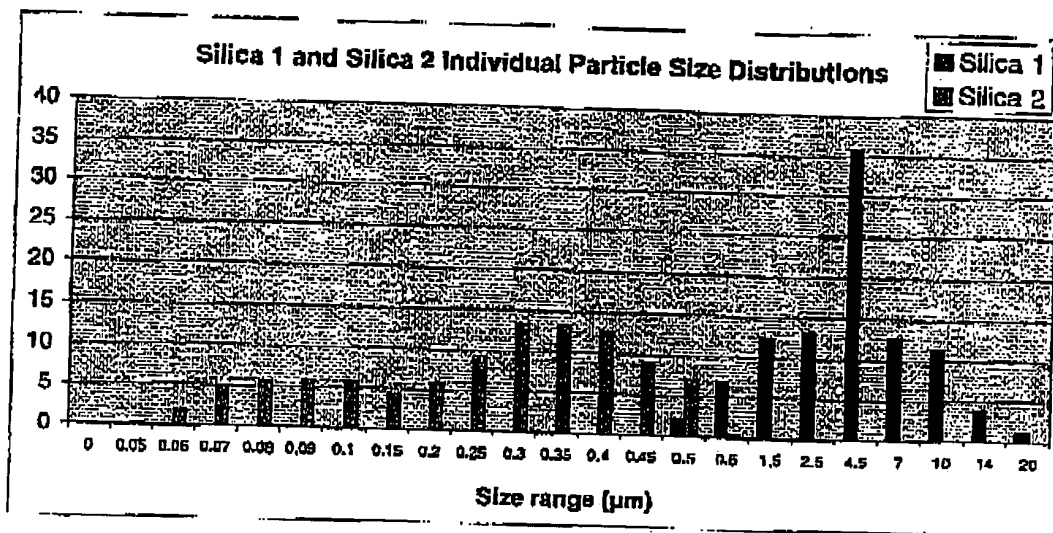
Type 30

One or both wires
curved toward each other
one of the wires arranged
on top of the adjacent wire.



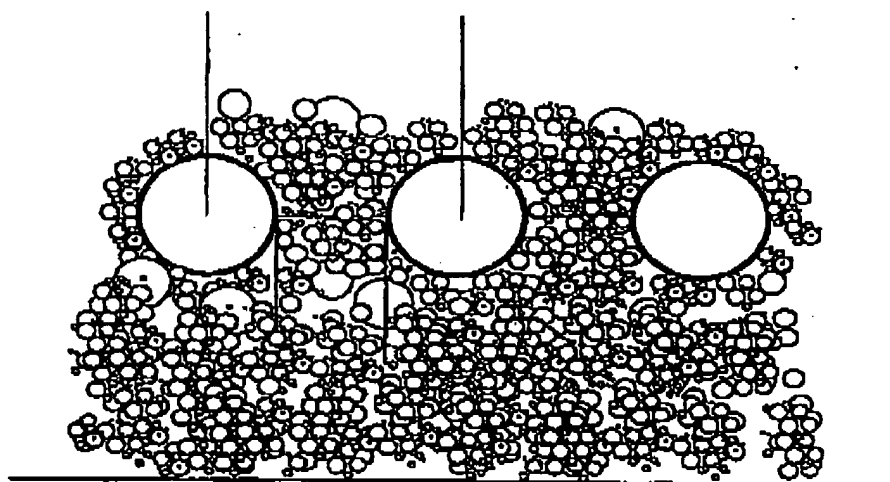
300.

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The silica particle size distribution chart titled:
Silica 1 and Silica 2 Individual Particle Size Distributions
explicitly defines the quantity of each size of particle when each of the
commercially available spherical silica (SiO₂) components are mapped
with respect to their individual ranges of diameter size. In this example,
the sum of the percentages for Silica 1 is equal to 100% and the sum
of the percentages for Silica 2 is equal to 100%.

The silica particle size distribution chart titled:
Silica (SiO₂) Particle Size Distribution
is the resultant spherical silica (SiO₂) size range distribution
when a quantity of 10 parts of Silica 1 is added to a quantity
of 3 parts Silica 2. In this example, the sum of the percentages
for the Silica mixture is equal to 100%.



The silica particle size distribution chart titled:

Silica 1 and Silica 2 Individual Particle Size Distributions

explicitly defines the quantity of each size of particle when each of the commercially available spherical silica (SiO₂) components are mapped with respect to their individual ranges of diameter size. In this example, the sum of the percentages for Silica 1 is equal to 100% and the sum of the percentages for Silica 2 is equal to 100%.

The individual distribution of the silica diameter sizes for the type of spherical silica designated Silica 1 is specified by the following quantities within the stated size range:

0%	greater than 24 microns
1.1%	less than 24 microns and greater than 16 microns
4.0%	less than 16 microns and greater than 12 microns
11.5%	less than 12 microns and greater than 8 microns
12.8%	less than 8 microns and greater than 6 microns
35.8%	less than 6 microns and greater than 3 microns
13.3%	less than 3 microns and greater than 2 microns
12.5%	less than 2 microns and greater than 1 micron
7.0%	less than 1 micron and greater than 0.5 micron
2.0%	less than 0.5 micron and greater than 0 micron

The individual distribution of the silica diameter sizes for the type of spherical silica designated Silica 2 is specified by the following quantities within the stated size range:

0%	greater than 0.6 micron
0.5%	less than 0.6 micron and greater than 0.5 micron
7.03%	less than 0.5 micron and greater than 0.45 micron
9.13%	less than 0.45 micron and greater than 0.4 micron
12.83%	less than 0.4 micron and greater than 0.35 micron
13.43%	less than 0.35 micron and greater than 0.3 micron
13.33%	less than 0.35 micron and greater than 0.3 micron
9.33%	less than 0.3 micron and greater than 0.25 micron
5.83%	less than 0.25 micron and greater than 0.2 micron
4.33%	less than 0.2 micron and greater than 0.15 micron
5.83%	less than 0.15 micron and greater than 0.1 micron
5.93%	less than 0.1 micron and greater than 0.09 micron
5.53%	less than 0.09 micron and greater than 0.08 micron
4.03%	less than 0.08 micron and greater than 0.07 micron
1.73%	less than 0.07 micron and greater than 0.06 micron
0.31%	less than 0.06 micron

The silica particle size distribution chart titled:

Silica (SiO₂) Particle Size Distribution

is the resultant spherical silica (SiO₂) size range distribution when a quantity of 10 parts of Silica 1 is added to a quantity of 3 parts Silica 2. In this example, the sum of the percentages for the Silica mixture is equal to 100%.

The resultant combined distribution of the silica diameter sizes for the type of spherical silica used in the material is specified by the following quantities within the stated size range:

0%	greater than 24 microns
0.85%	less than 24 microns and greater than 16 microns
3.08%	less than 16 microns and greater than 12 microns
8.85%	less than 12 microns and greater than 8 microns
9.85%	less than 8 microns and greater than 6 microns
27.54%	less than 6 microns and greater than 3 microns
10.23%	less than 3 microns and greater than 2 microns
9.62%	less than 2 microns and greater than 1 micron
5.5%	less than 1 micron and greater than 0.6 micron
3.16%	less than 0.6 micron and greater than 0.5 micron
2.11	less than 0.5 micron and greater than 0.45 micron
2.86	less than 0.45 micron and greater than 0.4 micron
3.1	less than 0.4 micron and greater than 0.35 micron
3.08	less than 0.35 micron and greater than 0.3 micron
2.15	less than 0.3 micron and greater than 0.25 micron
1.35	less than 0.25 micron and greater than 0.2 micron
1.0	less than 0.2 micron and greater than 0.15 micron
1.35	less than 0.15 micron and greater than 0.1 micron
1.37	less than 0.1 micron and greater than 0.09 micron
1.28	less than 0.09 micron and greater than 0.08 micron
1.14	less than 0.08 micron and greater than 0.07 micron
0.4	less than 0.07 micron and greater than 0.06 micron
0.07	less than 0.06 micron and greater than 0.05 micron
0	less than 0.05 micron